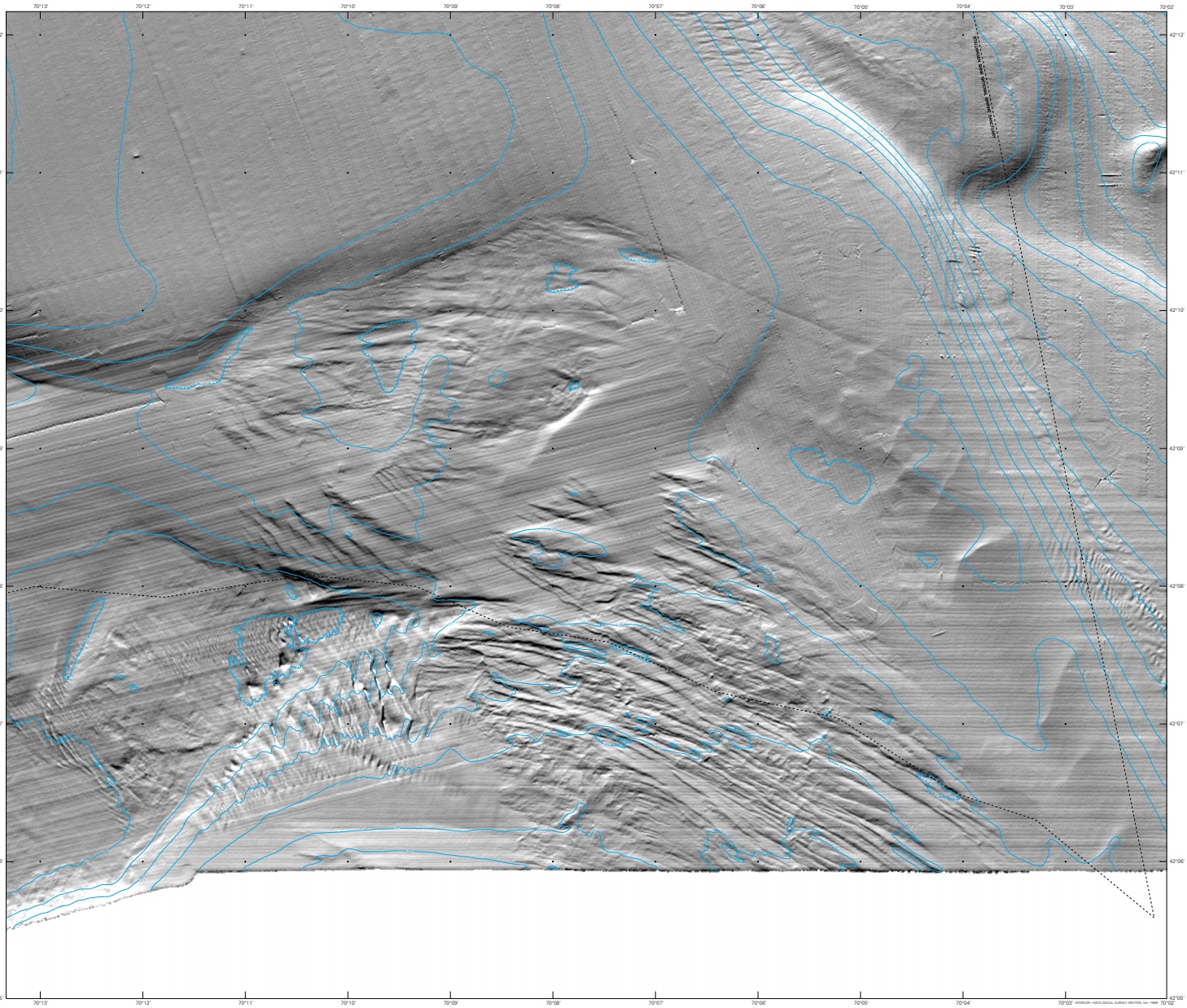
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

Prepared in cooperation with the
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

GEOLOGIC INVESTIGATIONS SERIES
MAP I–2703



Mercator projection

Geodetic Reference System 1980; North American Datum 1983
Longitude of central meridian 70°15' W.; latitude of true scale 41°39' N.
False easting 0 m; false northing 0 m

This map is not intended for navigational purposes.

SCALE 1:25,000
ONE CENTIMETER ON THE MAP REPRESENTS 250 METERS ON THE SEA FLOOR

1 .5 0 1 2 3 4 KILOMETERS
1 .5 0 1 2 NAUTICAL MILES

CONTOUR INTERVAL 5 METERS
DATUM IS MEAN LOWER LOW WATER

INTERIOR—GEOLOGICAL SURVEY, RESTON, VA.—1999

DISCUSSION

Introduction

The Stellwagen Bank National Marine Sanctuary Mapping Project is a cooperative effort of the U.S. Geological Survey and the National Oceanic and Atmospheric Administration, with support from the University of New Brunswick and the Canadian Hydrographic Service. The multibeam echo sounder survey was conducted on four cruises over a two-year period from the fall of 1994 to the fall of 1996. This map shows one of a series of 18 quadrangles (see location map) in which sea floor depth information is depicted in sun-illuminated (or shaded relief) view at a scale of 1:25,000, with topographic contours overprinted in blue. The image shown here uses a sun elevation angle of 45 degrees above the horizon from an azimuth of 350 degrees and a vertical exaggeration of four times. In effect, topographic relief is enhanced by having the sun illuminate the sea floor from a position 10 degrees west of north, so that shadows are cast on the southern flanks of seabed features. Some features in the images are artifacts of data collection. They are especially noticeable where the seabed is smooth, and they include small highs and lows and unnatural-looking features and patterns that are oriented parallel or perpendicular to survey tracklines. For a depiction of the topographic contours alone, and for an explanation of survey and topographic data-processing methods, see the companion map by Valentine and others (1997). Topographic contour maps of all 18 quadrangles in the map series are available on a CD-ROM in EPS, PS, Arc export, and PDF file formats (Valentine and others, 1998). Blank areas represent places where no data exists.

Regional seabed features

The major topographic features depicted in the map series were formed by glacial processes. In broad terms, these features are interpreted here to represent a geologic history that developed in several stages. Ice containing rock debris moved across the region, sculpting its surface and depositing sediment to form the large basins, banks, ridges, and valleys. Many other features observed here represent the latter stages of deglaciation. They are the result of processes at work when much of the area was covered by stationary rotting ice, and when at the same time small valley glaciers and ice falls were active in and near areas of high topographic relief. The sea invaded the region formerly occupied by ice, and seabed features were partly eroded and some new sedimentary deposits formed. Today, the sea floor is modified mainly by strong southwestward-flowing bottom currents caused by storm winds from the northeast. These currents erode sediments from the shallow banks and transport them into the basins. With time, the banks affected by these currents become coarser, as sand and mud are removed and gravel remains; and the western flanks of the banks, as well as adjacent basins, are built up by deposits of mud and sand.

Quadrangle 3 features

This quadrangle covers the southeast corner of Stellwagen Bank and the channel that separates the bank from Cape Cod to the south. In the northern part of the quadrangle, the bank surface slopes gently eastward through water depths of 30 to 55 m and is covered with coarse gravelly sand. A low scarp (5–10 m) at approximately 42°10' N. delineates the southern edge of the bank from the channel to the south. The sandy eastern edge of Stellwagen Bank lies in water depths of 55 to 80 m and extends southeastward to form the eastern threshold of the channel. The northern part of the eastern bank edge is dissected by shallow downslope gullies; the central part is smooth, probably the result of recent sediment deposition; and the southern part is covered by low bedforms oriented oblique to the slope of the seabed. The southern half of a poorly defined bank is located in the northeastern part of the quadrangle (42°11.6' N., 70°03.8' W.). The bank lies at 90 m water depth and is covered with sand and gravel and a partly buried gravel ridge. This bank is the southernmost of a series of banks, whose tops lie in 90 to 95 m of water, that extend from this quadrangle northward into Quadrangle 6 (Valentine and others, 1999b). The smooth valley south and east of the bank is floored with muddy sand.

The east-west channel that separates Stellwagen Bank from Cape Cod lies in water depths of 45 to 60 m. The shallow northern part of the channel floor is coarse-grained sand occurring as ripples and dunes in a discontinuous thin veneer on gravel. The deeper western and eastern parts of the channel floor are finer grained sand. The channel floor gradually deepens to the west in Quadrangle 2 (Valentine and others, 1999a), where it becomes muddy as it opens into Stellwagen Basin. Three distinct sets of low sand bedforms occur on the southern margin of the channel in Quadrangle 3. In the east (to seaward), elongated dunes oriented along-current and parallel to regional topography extend for 7 km around the northern face of Cape Cod. They merge at 70°09' W. with a western set of dunes that are oriented across-current and perpendicular to regional topography. Both bedform sets are composed of coarse sand, and the change in orientation may reflect a difference in the speeds of storm-wave currents and tidal currents in the channel, with the eastern part experiencing the strongest currents. A third set of bedforms, composed of finer grained sand, has formed in the deeper water (55–60 m) of the southwestern part of the quadrangle (42°07.6' N., 70°10.9' W. and 42°06.8' N., 70°12.7' W.). South of the bedform region, between 70°08' W. and 70°12' W., a smooth apron of coarse sand extends from the northern flank of Cape Cod into the channel.

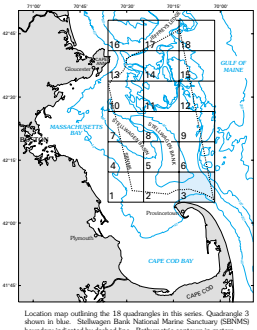
REFERENCES CITED

Valentine, P.C., Baker, J.L., Unger, T.S., and Rosworth, E.T., 1997, Sea floor topography of Quadrangle 3 in the Stellwagen Bank National Marine Sanctuary off Boston, Massachusetts: U.S. Geological Survey Open-File Report 97–504, scale 1:25,000.

Valentine, P.C., Baker, J.L., Unger, T.S., and Polloni, C., 1998, Sea floor topographic map and perspective-view imagery of Quadrangles 1–18, Stellwagen Bank National Marine Sanctuary off Boston, Massachusetts: U.S. Geological Survey Open-File Report 98–138, 1 CD-ROM.

Valentine, P.C., Unger, T.S., and Baker, J.L., 1999a, Sun-illuminated sea floor topography of Quadrangle 2 in the Stellwagen Bank National Marine Sanctuary off Boston, Massachusetts: U.S. Geological Survey Geologic Investigations Series Map I-2702, scale 1:25,000.

——1999b, Sun-illuminated sea floor topography of Quadrangle 6 in the Stellwagen Bank National Marine Sanctuary off Boston, Massachusetts: U.S. Geological Survey Geologic Investigations Series Map I-2706, scale 1:25,000.



Location map outlining the 18 quadrangles in this series. Quadrangle 3 shown in blue. Stellwagen Bank National Marine Sanctuary (SBNMS) boundary indicated by dashed line. Bathymetric contours in meters.

SUN-ILLUMINATED SEA FLOOR TOPOGRAPHY OF QUADRANGLE 3 IN THE STELLWAGEN BANK NATIONAL MARINE SANCTUARY OFF BOSTON, MASSACHUSETTS

By

Page C. Valentine, Jessica L. Baker, and Tanya S. Unger

1999

For sale by U.S. Geological Survey, Information Services, Box 25286, Federal Center, Denver, CO 80225

For more information contact:
Page Valentine, U.S. Geological Survey,
384 Woods Hole Road, Woods Hole, MA 02543

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